

Class 2 Permissive Change Test Report

FCC Part 15.247 Frequency Hopping

for

Symbol Technologies

on the

Wireless LAN System

Model: LA3021-100

FCC ID: H9PLA3021-100

Test Report #: 2036369G5

Date of Report: July 2, 2001

Job #: J20036369G

Date of Test: April 5 & 6, 2001

Total No of Pages Contained in this Report: 27



Wurck Hersey



NVLAP[®]

NVLAP Laboratory Code: 200201-0

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	David Chernomordik, Ph.D., Technical Manager

Review Date: _____

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FCC Part 15 F11SS Cert. Rev 01/01



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Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

1.0 Introduction

1.1 Justification

Two new antennas were added to the device which was originally granted.

No changes were made in the RF module and modulator, therefore no changes are expected in Power Output, 20 dB Bandwidth, Number of hopping channels, Channel occupancy time, Out-of-band Antenna Conducted Emission.

Only radiated emission test was performed to confirm that the device is in compliance with FCC Part 15 requirements.

1.2 Summary of Tests

MODEL: Model: LA3021-100 FCC ID: H9PLA3021-100

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	Not Applicable *
20 dB Bandwidth	15.247(a)(2)	Not Applicable *
Min. Channel Separation	15.247(a)(1)	Not Applicable *
Min. Hopping Channels	15.247(a)(1)	Not Applicable *
Average Channel Occupancy Time	15.247(a)(1)	Not Applicable *
Out-of-band Antenna Conducted Emission	15.247(c)	Not Applicable *
Out-of-band Radiated Emission	15.247(c)	Not Applicable **
Radiated Emission in Restricted Bands	15.35(b)(c)	Passed
AC Conducted Emission	15.207	Not Applicable *
Radiated Emission from Digital Part	15.109	Passed
Radiated Emission from Receiver L.O.	15.109	Not Applicable ***
Antenna Requirement	15.203	Passed

* There are no changes which can affect these characteristics (See Section 1.1 for details).

** The EUT passed Out-of-band Antenna Conducted Emission

*** The EUT operates above 960 MHz

Symbol Technologies. Model # LA3021-100

Date of Test: April 5 & 6, 2001

FCC ID: H9PLA3021-100

2.0 General Description

2.1 Product Description

The Symbol Technologies model H9PLA3021-100 is 2.4 GHz Spread Spectrum radio in the form of a PCMCIA card that is used for wireless communication from a computer to a LAN.

Overview of Wireless LAN System

Applicant	Symbol Technologies
Trade Name & Model No.	Symbol, LA4121
FCC Identifier	H9PLA3021-100
Use of Product	Wireless LAN communications
Manufacturer & Model of Spread Spectrum Module	Symbol
Type of Transmission	Frequency Hopping Spread Spectrum
Rated RF Output	66 mW
Frequency Range	2412 - 2462
Number of Channel(s)	79
Antenna(s) & Gain,	PMAA-2000 and MAA-2000, max Gain 8 dBi
Antenna Requirement	<p><input type="checkbox"/> The EUT uses a permanently connected antenna.</p> <p><input checked="" type="checkbox"/> The antenna is affixed to the EUT using a unique connector which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector.</p> <p><input type="checkbox"/> The EUT requires professional installation (attach supporting documentation if using this option).</p>
Manufacturer name & address	Symbol

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Radiated emissions measurements were performed according to the procedures in ANSI C63.4 (1992). Radiated tests were performed at an antenna to LA4121 distance of 3 meters, unless stated otherwise in the "Data Sheet" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

The open area test site and conducted measurement facility used to collect the radiated data is site 2 located in Menlo Park, California. This test facility and site measurement data have been fully placed on file with the FCC.

Symbol Technologies. Model # LA3021-100

Date of Test: April 5 & 6, 2001

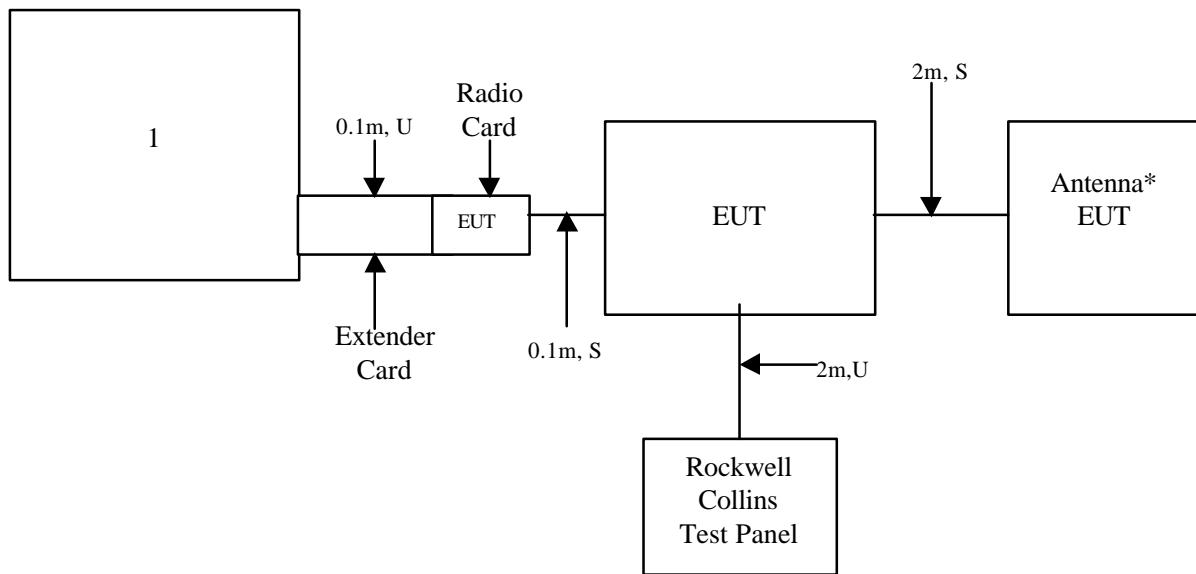
FCC ID: H9PLA3021-100

3.0 System Test Configuration

3.1 Support Equipment and description

Item #	Description	Model No.	Serial No.	FCC ID
1	Dell Computer	POS3410-N500	F999999	DoC

3.2 Block Diagram of Test Setup



*: Antenna 1 – MAA-2000, Antenna 2 – PMAA-2000

m: Length in meters

U: Unshielded

S: Shielded

Symbol Technologies. Model # LA3021-100

Date of Test: April 5 & 6, 2001

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3.3 Justification

For emission testing, the only way to put the equipment under test (EUT) into test mode (to make it transmit on a particular channel) was to configure it as follows:

The chassis cover of the WLU-2001 was removed. The LA3021-100 was removed from the chassis of the WLU-2001 and was inserted into an extender card which was connected to the PCMCIA slot of a laptop computer. The laptop computer has special software to put the LA3021-100 into test mode. The RF port of the LA3021-100 was connected to the WLU-2001 as it would be in normal installation.

During testing, all cables were manipulated to produce worst case emissions.

For radiated emission measurements the EUT is placed on the wooden turntable. The EUT is attached to peripherals and they are connected and operational (as typical as possible). The EUT is wired to transmit full power.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance.

Tests were performed for both the TWLU and CWLU modes of operation.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use.

3.5 Mode of Operation During Test

For emissions testing, the units were setup to transmit continuously at the low, middle, and high frequencies.

3.6 Modifications Required for Compliance

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by Rockwell Collins prior to compliance testing):

No modifications were installed by Intertek Testing Services.

4.0 Measurement Results

4.1 Transmitter Radiated Emissions in Restricted Bands FCC Rule 15.35(b), (c):

Radiated emission measurements were performed from 30 MHz to 25000 MHz.

For radiated emission tests, The analyzer setting was as followings:

	<u>RES BW</u>	<u>VID BW</u>
Frequency <1 GHz	100 kHz	100 kHz
Frequency >1 GHz	1 MHz – 1 MHz 1 MHz ≤ 100 Hz	(Peak measurements) (Average measurements)

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels).

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

The field strength at the Band-edge frequencies was calculated as $E_F = E_o - \Delta$.

Where:

E_F = Field Strength of Band-edge Frequency

E_o = Field Strength of Fundamental Frequency

Δ = Delta between the level of conducted emission at a Fundamental Frequency and the level of conducted emission at a Band-edge Frequency

Average Field strength at Low Channel 2402.0 MHz = 119.5 dBuV/m

Field strength at Band-edge 2390.0 MHz = 119.5 – 65.2 = 54.3 dBuV/m

The radio has a Duty cycle of 3.7 dB. Taking this into account the level at the Band-edge is 54.3 – 3.7 = 50.6 dBuV/m. Refer to the attached Duty Cycle calculation sheets.

Field strength at High Channel 2480.0 MHz = 119.5 dBuV/m

Field strength at Band-edge 2483.5 MHz = 119.5 – 68.5 = 51.0 dBuV/m

Refer to plots 6a – 6d for details.

Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

Job No.:	J20036369										
Company:	Symbol										
Model:	w/ MAA-2000 Antenna										
Test Mode:	CWLW FH - Tx @ Low Channel 2402 MHz										
Engineer:	Ollie Moyrong										
Date:	April_4_2001										

FCC Part 15.247 Radiated Emissions

Frequency (MHz)	Spec. Analyzer Detector	Antenna Location	Antenna Polariz.	Reading (dBuV)	Antenna Factor	Preamp (dB/m)	Correction (dB)	Cable (dB)	Duty (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2402.0	A	3.0	H	85.8	31.4	0.0	0.0	2.3	0.0	119.5	N/A	N/A
2402.0	P	3.0	H	86.3	31.4	0.0	0.0	2.3	0.0	120.0	N/A	N/A
4804.0	A	3.0	V	38.0	34.9	-28.1	0.0	3.2	0.0	48.0	54.0	-6.0
4804.0	P	3.0	V	42.7	34.9	-28.1	0.0	3.2	0.0	52.7	74.0	-21.3
12010.0	A	3.0	V	32.9	41.8	-33.0	0.0	5.9	0.0	47.6	54.0	-6.4
12010.0	P	3.0	V	42.6	41.8	-33.0	0.0	5.9	0.0	57.3	74.0	-16.7
19216.0	A	1.0	V	34.3	40.2	-24.0	-9.5	7.7	0.0	48.7	54.0	-5.3
19216.0	P	1.0	V	44.2	40.2	-24.0	-9.5	7.7	0.0	58.6	74.0	-15.4

Notes: *: indicates noise floor measurements with RBW @ 1MHz

**: indicates noise floor measurements with RBW @ 300 kHz

Job No.:	J20036369										
Company:	Symbol										
Model:	w/ MAA-2000 Antenna										
Test Mode:	CWLU FH - Tx @ High Channel 2480 MHz										
Engineer:	Ollie Moyrong										
Date:	April_4_2001										

FCC Part 15.247 Radiated Emissions

Frequency (MHz)	Spec. Analyzer Detector	Antenna Location	Antenna Polariz.	Reading (dBuV)	Antenna Factor	Preamp (dB/m)	Correction (dB)	Cable (dB)	Duty (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2480.0	A	3.0	H	85.8	31.4	0.0	0.0	2.3	0.0	119.5	N/A	N/A
2480.0	P	3.0	H	86.5	31.4	0.0	0.0	2.3	0.0	120.2	N/A	N/A
4960.0	A	3.0	V	39.2	34.9	-28.1	0.0	3.2	0.0	49.2	54.0	-4.8
4960.0	P	3.0	V	44.2	34.9	-28.1	0.0	3.2	0.0	54.2	74.0	-19.8
7440.0	A	3.0	V	26.0	38.3	-28.0	0.0	4.6	0.0	40.9	54.0	-13.1
7440.0	P	3.0	V	36.6	38.3	-28.0	0.0	4.6	0.0	51.5	74.0	-22.5
12400.0	A	3.0	V	33.0	41.8	-33.0	0.0	5.9	0.0	47.7	54.0	-6.3
12400.0	P	3.0	V	42.1	41.8	-33.0	0.0	5.9	0.0	56.8	74.0	-17.2
19840.0	A	1.0	V	35.0	40.2	-24.0	-9.5	7.7	0.0	49.4	54.0	-4.6
19840.0	P	1.0	V	44.6	40.2	-24.0	-9.5	7.7	0.0	59.0	74.0	-15.0
22320.0	A	1.0	V	32.6	40.3	-24.0	-9.5	8.5	0.0	47.9	54.0	-6.1
22320.0	P	1.0	V	41.3	40.3	-24.0	-9.5	8.5	0.0	56.6	74.0	-17.4
Notes:	*: indicates noise floor measurements with RBW @ 1MHz											
	**: indicates noise floor measurements with RBW @ 300 kHz											
	All frequencies measured with EUT in CW Test Mode except for 7440 MHz measured with EUT operating in normal mode											

Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

Job No.:	J20036369										
Company:	Symbol										
Model:	w/ MAA-2000 Antenna										
Test Mode:	CWLU FH - Tx @ Mid Channel 2442 MHz										
Engineer:	Ollie Moyrong										
Date:	April_4_2001										

FCC Part 15.247 Radiated Emissions

Frequency (MHz)	Spec. Analyzer Detector	Antenna Location	Antenna Polariz.	Reading (dBuV)	Antenna Factor	Preamp (dB/m)	Correction (dB)	Cable (dB)	Duty (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2442.0	A	3.0	H	84.0	31.4	0.0	0.0	2.3	0.0	117.7	N/A	N/A
2442.0	P	3.0	H	84.6	31.4	0.0	0.0	2.3	0.0	118.3	N/A	N/A
4884.0	A	3.0	V	37.6	34.9	-28.1	0.0	3.2	0.0	47.6	54.0	-6.4
4884.0	P	3.0	V	42.6	34.9	-28.1	0.0	3.2	0.0	52.6	74.0	-21.4
7326.0	A	3.0	V	25.9	38.3	-28.0	0.0	4.6	0.0	40.8	54.0	-13.2
7326.0	P	3.0	V	36.4	38.2	-28.0	0.0	4.6	0.0	51.2	74.0	-22.8
12210.0	A	3.0	V	32.8	41.8	-33.0	0.0	5.9	0.0	47.5	54.0	-6.5
12210.0	P	3.0	V	42.5	41.8	-33.0	0.0	5.9	0.0	57.2	74.0	-16.8
19536.0	A	1.0	V	34.4	40.2	-24.0	-9.5	7.7	0.0	48.8	54.0	-5.2
19536.0	P	1.0	V	44.7	40.2	-24.0	-9.5	7.7	0.0	59.1	74.0	-14.9
21978.0	A	1.0	V	31.9	40.3	-24.0	-9.5	7.9	0.0	46.6	54.0	-7.4
21978.0	P	1.0	V	41.4	40.3	-24.0	-9.5	7.9	0.0	56.1	74.0	-17.9
Notes:	*: indicates noise floor measurements with RBW @ 1MHz											
	**: indicates noise floor measurements with RBW @ 300 kHz											
	7326 MHz measured with EUT operating in normal mode											
	All frequencies measured with EUT in CW Test Mode except for 7326 MHz measured with EUT operating in normal mode											

Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

Job No.:	J20036369										
Company:	Symbol										
Model:	w/ PMAA-2000 Antenna										
Test Mode:	CWLU FH - Tx @ Low Channel 2402 MHz										
Engineer:	Ollie Moyrong										
Date:	April_4_2001										

FCC Part 15.247 Radiated Emissions

Frequency (MHz)	Spec. Analyzer Detector	Antenna Location	Antenna Polariz.	Reading (dBuV)	Antenna (dB/m)	Preamp Factor	Correction Factor	Cable Loss	Duty Cycle	Corrected Reading (dBuV/m)	Limit At 3 m (dBuV/m)	Margin (dB)
2402.0	A	3.0	H	79.1	31.4	0.0	0.0	2.3	0.0	112.8	N/A	N/A
2402.0	P	3.0	H	79.6	31.4	0.0	0.0	2.3	0.0	113.3	N/A	N/A
4804.0	A	3.0	H	36.7	34.9	-28.1	0.0	3.2	0.0	46.7	54.0	-7.3
4804.0	P	3.0	H	41.5	34.9	-28.1	0.0	3.2	0.0	51.5	74.0	-22.5
12010.0	A	3.0	V	33.6	41.8	-33.0	0.0	5.9	0.0	48.3	54.0	-5.7
12010.0	P	3.0	V	43.8	41.8	-33.0	0.0	5.9	0.0	58.5	74.0	-15.5
19216.0	A	1.0	V	34.3	40.2	-24.0	-9.5	7.7	0.0	48.7	54.0	-5.3
19216.0	P	1.0	V	44.2	40.2	-24.0	-9.5	7.7	0.0	58.6	74.0	-15.4

Notes: *: indicates noise floor measurements with RBW @ 1MHz

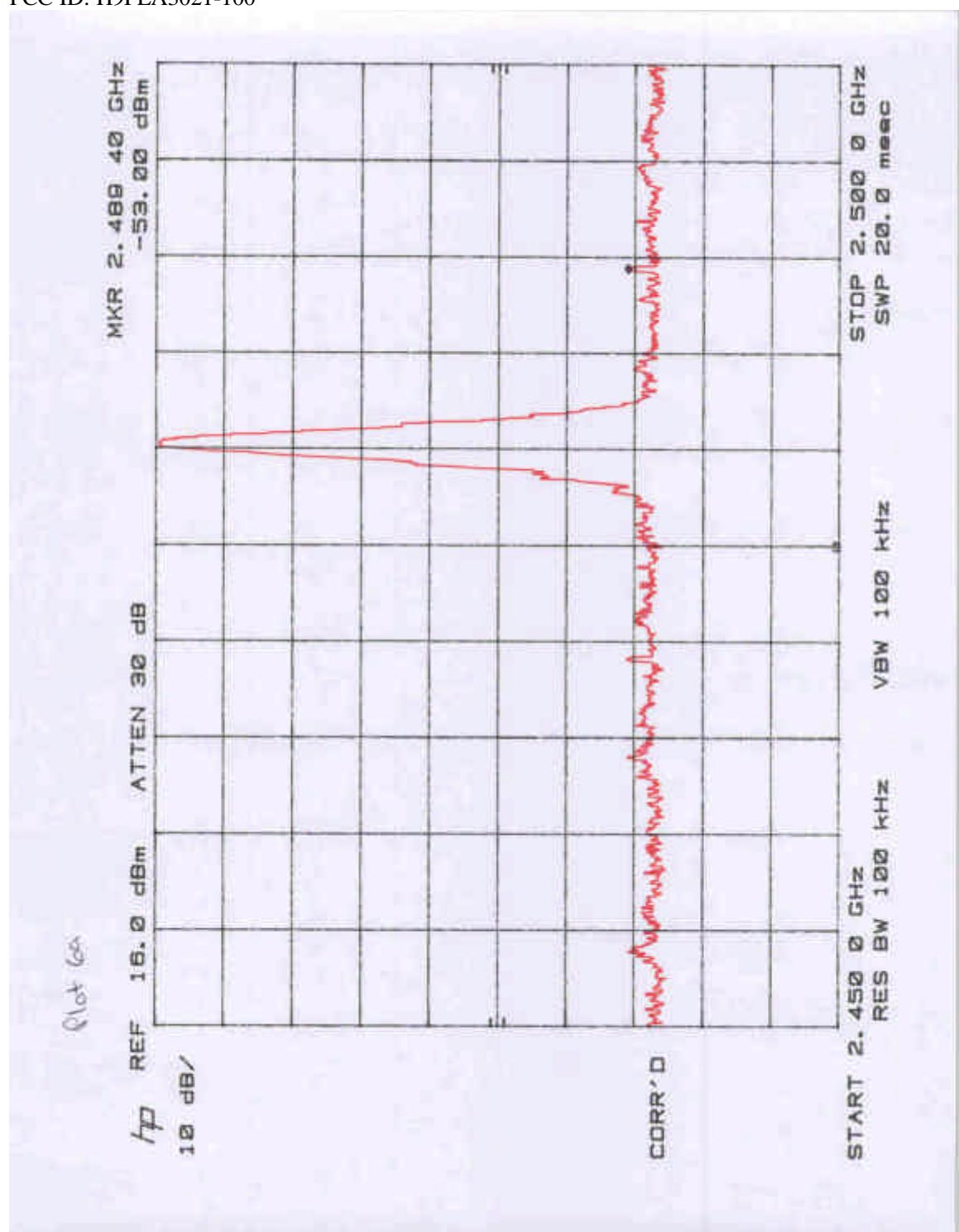
Job No.:	J20036369										
Company:	Symbol										
Model:	w/ PMAA-2000 Antenna										
Test Mode:	CWLU FH - Tx @ High Channel 2480 MHz										
Engineer:	Ollie Moyrong										
Date:	April_4_2001										

FCC Part 15.247 Radiated Emissions

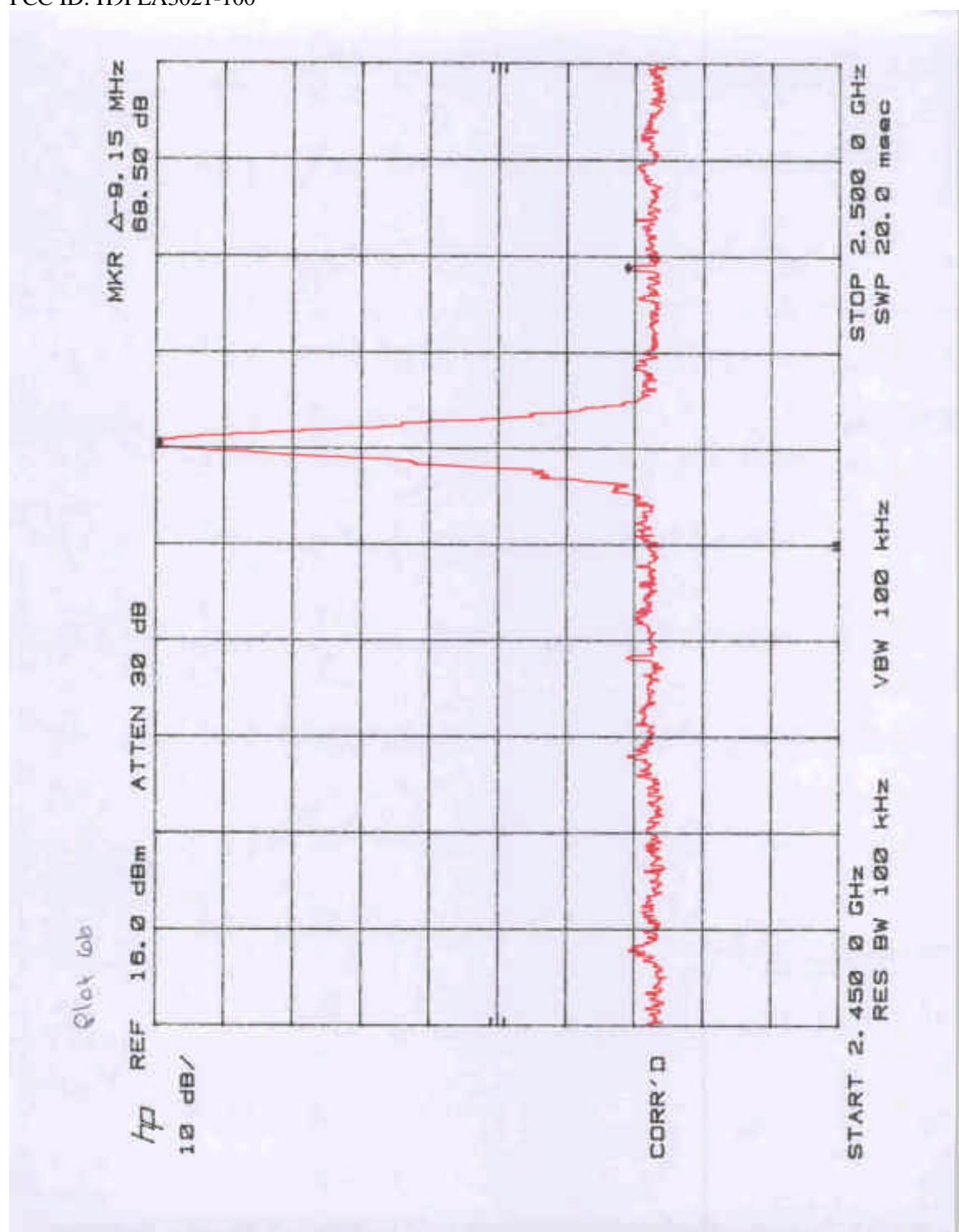
Frequency (MHz)	Spec. Analyzer Detector	Antenna Location	Antenna Polariz.	Reading (dBuV)	Antenna Factor	Preamp (dB/m)	Correction (dB)	Cable (dB)	Duty (dB)	Corrected (dBuV/m)	Limit (dBuV/m)	Margin (dB)
2480.0	A	3.0	H	81.4	31.4	0.0	0.0	2.3	0.0	115.1	N/A	N/A
2480.0	P	3.0	H	81.9	31.4	0.0	0.0	2.3	0.0	115.6	N/A	N/A
4960.0	A	3.0	V	36.7	34.9	-28.1	0.0	3.2	0.0	46.7	54.0	-7.3
4960.0	P	3.0	V	41.1	34.9	-28.1	0.0	3.2	0.0	51.1	74.0	-22.9
7440.0	A	3.0	V	25.8	38.3	-28.0	0.0	4.6	0.0	40.7	54.0	-13.3
7440.0	P	3.0	V	36.4	38.3	-28.0	0.0	4.6	0.0	51.3	74.0	-22.7
12400.0	A	3.0	V	32.2	41.8	-33.0	0.0	5.9	0.0	48.7	54.0	-5.3
12400.0	P	3.0	V	41.9	41.8	-33.0	0.0	5.9	0.0	58.4	74.0	-15.6
19840.0	A	1.0	V	35.0	40.2	-24.0	-9.5	7.7	0.0	50.2	54.0	-3.8
19840.0	P	1.0	V	44.6	40.2	-24.0	-9.5	7.7	0.0	59.8	74.0	-14.2
22320.0	A	1.0	V	32.6	40.3	-24.0	-9.5	8.5	0.0	47.9	54.0	-6.1
22320.0	P	1.0	V	41.3	40.3	-24.0	-9.5	8.5	0.0	56.6	74.0	-17.4
Notes:	*: indicates noise floor measurements with RBW @ 1MHz											
	**: indicates noise floor measurements with RBW @ 300 kHz											
	All frequencies measured with EUT in CW Test Mode except for 7440 MHz measured with EUT operating in normal mode											

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Company:	Symbol										
Model:	w/ PMAA-2000 Antenna										
Test Mode:	CWLW FH - Tx @ Mid Channel 2442 MHz										
Engineer:	Ollie Moyrong										
Date:	April_4_2001										
FCC Part 15.247 Radiated Emissions											
Frequency	Spec.	Antenna	Antenna	Reading	Antenna	Preamp	Correction	Cable	Duty	Corrected	Limit
(MHz)	Analyzer Detector	Location (m)	Polariz. (H/V)	(dBuV)	(dB/m)	(dB)	(dB)	(dB)	(dB)	(dBuV/m)	(dBuV/m)
2442.0	A	3.0	H	79.4	31.4	0.0	0.0	2.3	0.0	113.1	N/A
2442.0	P	3.0	H	80.0	31.4	0.0	0.0	2.3	0.0	113.7	N/A
4884.0	A	3.0	V	35.4	34.9	-28.1	0.0	3.2	0.0	45.4	54.0
4884.0	P	3.0	V	40.3	34.9	-28.1	0.0	3.2	0.0	50.3	74.0
7326.0	A	3.0	V	25.9	38.3	-28.0	0.0	4.6	0.0	40.8	54.0
7326.0	P	3.0	V	37.0	38.2	-28.0	0.0	4.6	0.0	51.8	74.0
12210.0	A	3.0	V	32.0	41.8	-33.0	0.0	5.9	0.0	46.7	54.0
12210.0	P	3.0	V	41.8	41.8	-33.0	0.0	5.9	0.0	56.5	74.0
19536.0	A	1.0	V	34.4	40.2	-24.0	-9.5	7.7	0.0	48.8	54.0
19536.0	P	1.0	V	44.7	40.2	-24.0	-9.5	7.7	0.0	59.1	74.0
21978.0	A	1.0	V	31.9	40.3	-24.0	-9.5	7.9	0.0	46.6	54.0
21978.0	P	1.0	V	41.4	40.3	-24.0	-9.5	7.9	0.0	56.1	74.0
Notes:	*: indicates noise floor measurements with RBW @ 1MHz										
	**: indicates noise floor measurements with RBW @ 300 kHz										
	All frequencies measured with EUT in CW Test Mode except for 7326 MHz measured with EUT operating in normal mode										

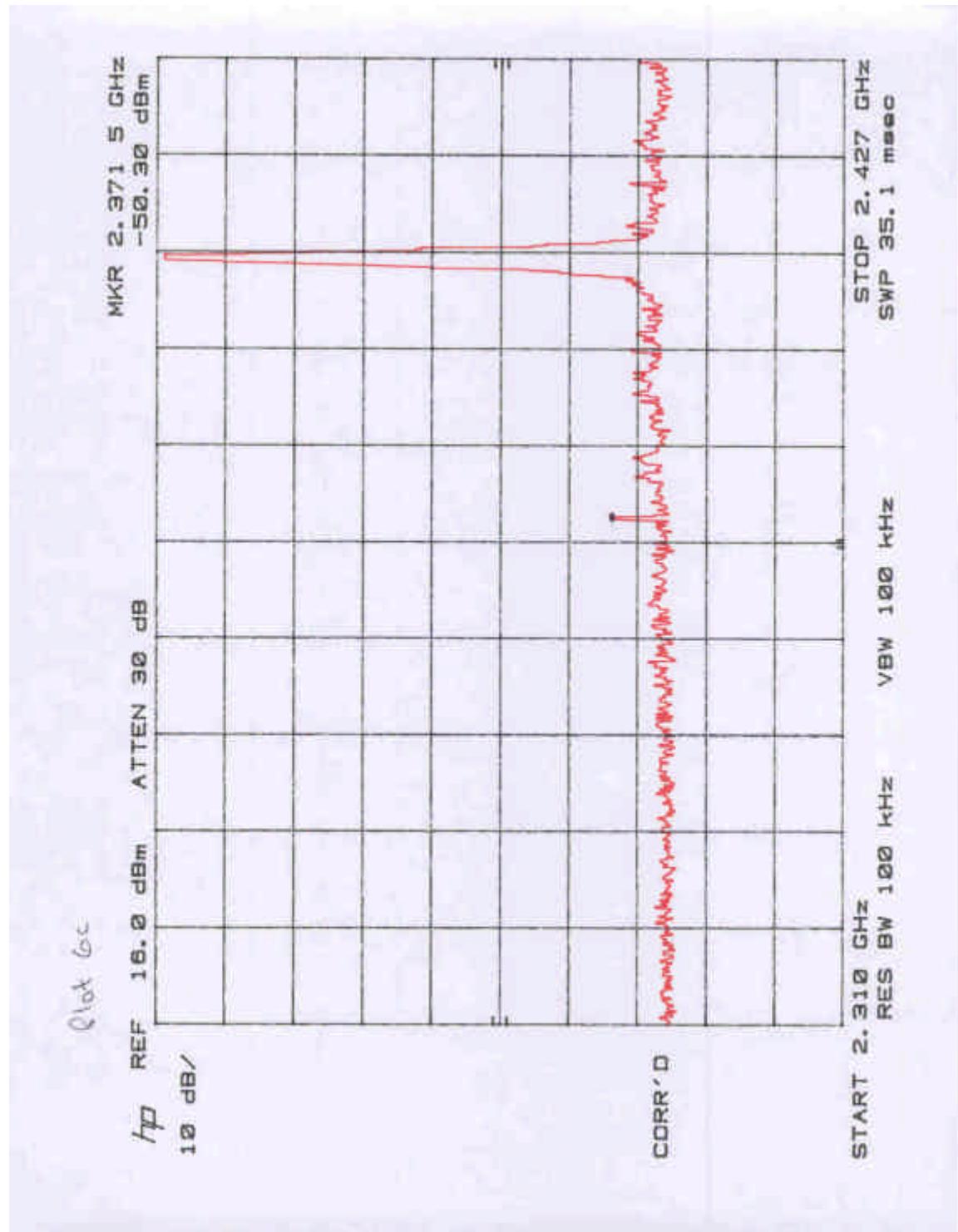
Plot 6a, High Channel 2480 MHz



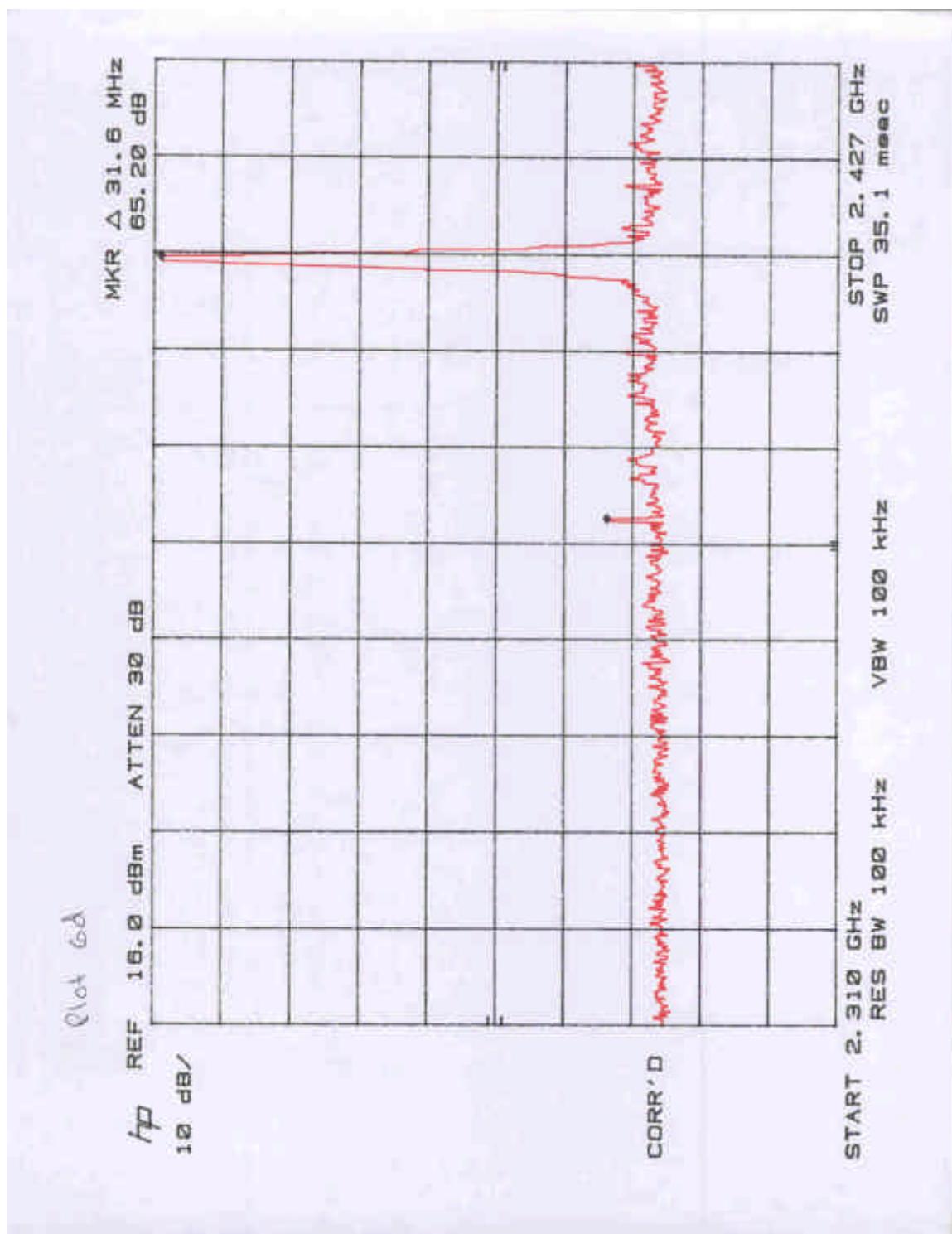
Plot 6.b, High Channel 2480 MHz



Plot 6c, Low Channel 2402 MHz



Plot 6d, Low Channel 2402 MHz



Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

4.2 Radiated Emissions from Digital Section of Transceiver (Transmitter)
FCC Ref: 15.109

Test results are attached

ITS Intertek Testing Services
ETL SEMKO

1365 Adams Court Menlo Park, CA 94025

Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

Intertek Testing Services					
Radiated Emissions 30 MHz - 1000 MHz					
FCC Part 15 Class B (QP-Vertical)					
Model Number: CWTU ITS Job Number: 320036369 Company: Rockwell Collins					
Operator: Barry Smith	01:34:18 PM, Friday, April 06, 2001	1	2	3	4
Frequency MHz	Quasi Pk Level (dBmV/m)	Limit@1m (dBmV/m)	Margin (dB)	Reading (dBmV)	CF (dB)
399.964 MHz	18.5	35.5	-17.0	29.5	-11.1
419.96 MHz	25.8	35.5	-9.7	36.6	-10.8
424.959 MHz	25.3	35.5	-10.2	36.0	-10.7
440.0025 MHz	29.3	35.5	-6.2	39.4	-10.1
449.9595 MHz	30.8	35.5	-4.7	40.5	-9.7
459.9975 MHz	22.0	35.5	-13.5	31.4	-9.4
Reading: Receiver Reading CF: Correction Factor (Includes Antenna Factor, Cable Loss, Preamp Gain, and Attenuator)					

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ITS Intertek Testing Services
ETL SEMKO

1365 Adams Court Menlo Park, CA 94025

Symbol Technologies. Model # LA3021-100
FCC ID: H9PLA3021-100

Date of Test: April 5 & 6, 2001

Intertek Testing Services Radiated Emissions 30 MHz - 1000 MHz FCC Part 15 Class B (OP-Vertical)					
Operator: Barry Smith 11:42:16 AM, Friday, April 06, 2001		Model Number: TWO ITS Job Number: J20036369 Company: Rockwell Collins			
Frequency MHz	Quasi Pk Level (dBuV/m)	Limit@10m (dBuV/m)	Margin (dB)	Reading (dBuV)	CF (dB)
216.777 MHz	4.8	35.5	-30.7	22.1	-17.3
449.9605 MHz	25.3	35.5	-10.2	35.0	-9.7
480.001 MHz	25.1	35.5	-10.4	34.9	-9.8
489.9575 MHz	26.5	35.5	-9.0	36.3	-9.6
500.0005 MHz	28.5	35.5	-7.0	37.6	-9.1
509.9585 MHz	20.9	35.5	-14.6	29.2	-8.3

Reading: Receiver Reading
CF: Correction Factor (includes Antenna Factor,
Cable Loss, Preamp Gain, and Attenuator)

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Symbol Technologies. Model # LA3021-100

Date of Test: April 5 & 6, 2001

FCC ID: H9PLA3021-100

5.0 Document History

Revision/ Job Number	Writer Initials	Date	Change
1.0 / J20036369G4		June 30, 2001	Original document